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November 7, 2001

Mr. Michael Holland
Manager, Brookhaven Area Office
U.S. Department of Energy
Building 464
Upton, NY 11973

SUBJECT: ARR Recommendation for RHIC Routine Operations using Polarized Protons

Dear Mr. Holland:

Attached for your review is the report of the ARR Team review of RHIC for transition from commissioning to routine operations with polarized protons. The conclusion of the ARR Team is that the C-A Department and RHIC are prepared to commence routine operations with polarized protons.

We request BAO authorization for routine operations of RHIC with polarized protons. If you have any questions, please contact Henry Kahnhauser on Ext. 7509.

Sincerely yours,

Thomas R. Sheridan
Deputy Director, Operations

TRS/lim
Attachment
cc: H. Kahnhauser
D. Lowenstein
S. Ozaki
S. Layendecker
E. Lessard ✓
D. Beavis
T. Dickinson
P. Kelley, DOE/BAO

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for the U.S. Department of Energy

Memo

date: *November 5, 2001*

to: *T. Sheridan*

from: *H. Kahnhauser, ARR Team Leader* HK

subject: ***ARR Recommendation for RHIC Routine Operations using Polarized Protons***

Attached is the report of the ARR Team reviewing the RHIC for transition from commissioning to routine operations with polarized protons. The conclusion of the ARR Team is that the C-A Department and RHIC are prepared to commence routine operations with polarized protons. There are no "pre-start" items. However, there is one "post-start" item from a previous ARR, which has no impact the current safe operation of RHIC.

This is the last review module for the ARR Team. With the submission of this report, the Team has concluded all its tasks from the March 21, 1995, RHIC ARR Team Charter and letter of appointment.

If you have, any questions please contact me at extension 7509 or digital pager 453-5445.

Attachment

Cc: S. Ozaki
D. Lowenstein
S. Layendecker
E. Lessard
D. Beavis
T. Dickinson
P. Kelley, DOE

ACCELERATOR READINESS REVIEW REPORT

POLARIZED PROTONS ROUTINE OPERATIONS

November 2, 2001

ARR Team:

H. Kahnhauser, Chair

D. Beavis

T. Dickinson

P. Kelley, DOE Observer

Introduction

The Accelerator Readiness Review for RHIC has occurred in four distinct stages. First the AGS to RHIC (ATR) review; second the Sextant review, third the low intensity heavy ion commissioning and routine heavy ion operations, and polarized proton commissioning and now routine operations. In this phase of the readiness, review the team has been tasked to verify if the Collider Accelerator Department (C-AD) is prepared to commence routine operations of RHIC with polarized protons. The ARR Team reports to the Deputy Director for Operations. This report to the Deputy Director for Operations includes findings, observations, follow-up actions, both pre-start and post-start, and any final recommendations. The C-AD will track all pre and post start items to closure and evidence of closure will be provided to the RHIC ARR Chair or his designee.

This phase of the ARR deliberations does not include operations with particles other than polarized protons. The ARR Team concurs with C-AD that the existing operating envelope of protons and gold ions into RHIC define two limiting cases of hazard. Intermediate species of ions pose a risk that is likely to be somewhere between these two limiting cases. The hazard and operational limits for a given species of ion will need to be analyzed by C-AD. These limits need to be defined in a safety document that is reviewed and approved by the C-AD Radiation Safety Committee, C-AD management, and DOE.

The charge of the ARR Team is to sample the RHIC processes to verify that the policies, conduct of operations, internal safety review program, configuration control systems, and equipment are in place prior to recommending approval for routine operations with polarized protons to BNL Management.

Review process and methodologies

Although each module of the ARR had a different scope, each module reviewed the appropriate safety documentation, any associated requirements and the proposed operational safety envelope. The Team sampled the C-AD program and processes, to ensure safe operations. This review focused upon the C-AD's process of closing out prior ARR open items, the polarized proton fault studies, and the subsequent follow-up actions.

Conclusions

The ARR Team recommends approval of C-AD to begin routine operations with polarized protons.

Observations

Conduct of Operations

In the transition from commissioning to routine operations two issues, needed to be reviewed. The first issue was the conduct of the faults studies that were performed to validate the estimated radiation levels through the facility shielding. These fault studies were needed to verify additional actions were not needed to mitigate the hazard. The second issue reviewed was the status of the prior open post start issues and their method of closure.

Fault Study Results and Closure

C-AD fault studies for polarized protons were conducted on August 25,2000, and were recorded in the Fault Study Book as studies #28 and #30. A report was written and presented to the C-AD Radiation Safety Committee (RSC). There were several meetings by the RSC from December 5,2000 through October 16, 2001 to review the data and to develop subsequent recommendations for C-AD to mitigate the hazard. It was determined that it was not practical to install enough "chipmunks" to see all potential faults. Instead, the RSC decided to limit intensity in the AGS ring using the A20 current transformer. The A20 current transformer will prevent the injection into RHIC of unacceptably high intensity polarized protons beams. This device will be set to limit the accelerated polarized proton intensity to $6x10^{11}$ protons per AGS cycle. Additionally, the injection of protons from the high intensity source is prevented by interlocked valves at the LINAC, if RHIC is ready to accept beam from the AGS. Polarized proton pulses with intensities above the limit will be detected by the A20 transformer, which will abort the acceleration process using the AGS beam inhibit system and close the LINAC to booster beam stops. Interlocking chipmunks are located in the early portions of the injection arcs over Thompson road; however, these "chipmunks" are not sensitive to the entire injection arcs but are placed in the locations where the maximal faults are most likely to occur. Additionally a non-interlocking "chipmunk" will monitor Railroad Avenue over the RHIC berm.

The A-20 current transformer has undergone an engineering design review certified by the Chief Engineer and has been placed into the C-AD configuration control system. The appropriate controlling procedure is TPL-01-18, Procedure to Limit the Number of Particles in the AtR Transfer Line. At the time of the review, five individuals have completed training on this procedure, which is more than the minimum number required by the procedure.

In summary, C-AD has met its requirement to conduct the required fault study, reviewed the data, and implemented the indicated additional actions required by the C-AD RSC. C-AD's implementation of the A20 Current Transformer was appropriately reviewed and approved by C-AD. The A20 current transformer has been entered into the configuration control system using the ECN system as implemented by C-AD.

Review of Previous Accelerator Readiness Review (ARR) Issues

The *Accelerator Readiness Review Report-Polarized Protons Commissioning*, dated August 30, 2000, page 3, states, "The status and closure [*of prior open ARR issues*] will be a review item in the routine operations ARR for polarized protons..."

As such, a review was performed of previous pre-start and post-start RHIC ARR items or issues. The following ARR reports were reviewed to identify these items:

- AGS to RHIC (ATR) Commissioning dated September 29, 1995.
- RHIC Sextant Commissioning dated January 24, 1997.
- RHIC Commissioning Without Beam, dated May 7, 1999.
- RHIC Low Intensity Heavy Ion Commissioning dated June 24, 1999.
- RHIC Routine Operations With STAR, PHENIX, PHOBOS, and BRAHMS, dated August 6, 1999.
- RHIC Polarized Proton Commissioning dated August 30, 2000.

Once the items were identified, reviews were performed of available documentation to ascertain the status or resolution of these items. Most items could be clearly tracked to resolution such as *physically* verifying the installation of hardware and the preparation or revision of procedures. Pre-start or post-start ARR action items that were the result of more recent ARRs are tracked by C-AD using the BNL Assessment Tracking System (ATS). It is recognized that the advent and use of ATS is relatively recent and was not available for early ARRs. Using the ATS for tracking ARR action items is of great value to:

- BNL personnel assigned the task or responsibility of completing the action item,
- BNL management to view a snapshot of the various ARR open and closed action items, and
- The ARR team and DOE itself in its task of verifying the status of ARR action items.

The C-AD's use of the ATS for tracking ARR action items is commendable. The use of ATS is encouraged for future ARR activities.

A caution is noted here that some ARR action items being tracked by ATS were closed based on pending or upcoming action. For example, ATS item 164.2.6—Automatic sprinkler protection for various cryogenic systems--is a multi-part ATS item covering the installation of sprinklers in building 1005R and a fire detection system in building 1005P. The action is closed in ATS. The documents supporting the closure of this item state that the actions (sprinkler and fire detection installation) are being planned and that planning was sufficient for closure of the action item in ATS. However, if the planned installations are not performed, someone quickly viewing the ATS action item may incorrectly conclude that the installation is complete when, in fact, it is not. There is no

longer a required feedback mechanism to the ATS (since the action is already closed) to further update the ATS item on the final installation. The condition owner (who reviews the action item before closing out the condition), however, would verify that the actions have been properly addressed. An additional review is also performed by the assessment owner. Although the ATS status of closed alone did not definitively provide evidence that the specified action has been performed, the C-AD ARR ATS Coordinator provided sufficient information (names, dates, e-mails, descriptive information, memos, etc.) to determine a point of contact for final resolution or status of an item. In addition, C-A QA is currently having discussions with the BNL Institutional ATS Administrators concerning a modification to the ATS to address verification of closed action items. This modification would require the condition/assessment owner to indicate whether independent verification is required on any closed action items. The ARR Team is not specifying this ATS practice as a pre- or post-start item. As previously stated, C-ADs use of the ATS for ARR action items is noteworthy.

A sample of the ARR action items were selected and more in depth reviews were performed to verify their status.

Training

Training issues were identified in the Sextant Commissioning ARR and later ARRs. As a result, C-AD prepared a "Plan To Improve C-A Department Training Program" which provides the framework for more effective training and qualification program. Based on the completion of the Plan, a review of selected training records, and discussions with the Training Coordinator, it is determined that the ARR training issues have been or are being resolved in a timely manner.

Operational Safety Limits

Operational Safety Limit items were identified in several ARRs. Mostly, the items involved the development of checklists or other configuration management controls.

Procedures

Items involving the preparation or revision to procedures (e.g., Operations Procedures) were identified in several ARRs.

Hardware/Equipment

Few hardware items were noted in the ARRs. When discussed, the hardware items pertained mostly to their use or control as opposed to missing or not installed hardware.

Previous Open ARR Issues Summary

Based on the review, the following ARR pre- and post- start action items are still considered open. The listed ARR reports are where the open items were first identified.

RHIC Routine Operations With STAR, PHENIX, PHOBOS, and BRAHMS, dated August 6, 1999

Assign post-start commitment dates to operational readiness review items.

a) Developing a testing program for cryogenic pressure relief valves.
b) Labeling of cryogenic piping
c) Continue to enhance the public address system in the RHIC tunnel.

RHIC Polarized Proton Commissioning, dated August 30, 2000

Prepare a postulated fault study where the beam traverses under Thompson Road and on the berm above the injection arcs.

Concerning the above items, it is noted that the operational readiness review items did have commitment action dates. The operational readiness review items are being listed in this report to document that these specific items remain open.

The items pertaining to the operational readiness review actions from the ARR report for RHIC Routine Operations With STAR, PHENIX, PHOBOS, and BRAHMS, dated August 6, 1999 remain as post-start items from that report.

Readiness Determination

The ARR Team recommends approval of the C-A Department's request to begin routine operations of RHIC using polarized protons.

Pre-Start Findings: None

Post-Start Finding: One

The items pertaining to the operational readiness review actions from the ARR report for RHIC Routine Operations With STAR, PHENIX, PHOBOS, and BRAHMS, dated August 6, 1999 remain as post-start items from that report.

Recommendations: None